Space-Based Reconnaissance

From a Strategic Past to a Tactical Future

We have limited ourselves to improving our strategic capabilities because, until recently, we have not had the technical ability to bring our Space-based assets to the tactical user. There are still many technical obstacles to overcome, but the idea of tactical Space-based reconnaissance is within reach.

By Maj. Robert A. Guerriero

Space-based reconnaissance is a cornerstone of the U.S. strategic intelligence capabilities. The United States has always been a pioneer in the area of Space-based reconnaissance, and today we are without peers. Our nation's reconnaissance satellites are some of the most sophisticated pieces of equipment that we produce. Most of our technical efforts to date have been directed toward improving our strategic reconnaissance capabilities. The soldier on the ground, however, needs tactical intelligence in order to be effective. Specific, timely, and accurate intelligence can give ground forces a decisive advantage on the battlefield.

While strategic reconnaissance is a great technological achievement, Space-based reconnaissance is still in its infancy. We have limited ourselves to improving our strategic capabilities because until recently we have not had the technical ability to bring our Space-based assets to the tactical user. There are still many technical obstacles to overcome, but the idea of tactical Space-based reconnaissance is within reach.

The National Reconnaissance Office is responsible for designing, building, and operating the nation's reconnaissance satellites. The office is divided into four directorates: Imagery Intelligence, Signals Intelligence, Communications, and Advanced Systems and Technology. The National Reconnaissance Office has also established an Operational Support Office to directly address tactical military concerns. It was not until 1992 that even the existence of the organization was publicly acknowledged; many of its activities and methods remain classified.

Our strategic intelligence capabilities did not come easily or without risk. The history of our strategic program begins with the Army Air Corps, the fledgling Air Force, and the newly formed Central Intelligence Agency (CIA).

The Birth of Strategic Reconnaissance

With the close of WWII and the detonation of atomic bombs over Japan, leaders in the United States realized that a new era was dawning. The World War II commander of U.S. Army Air Forces, General of the Army Henry H. Arnold, warned the Secretary of War that the country's leaders would require "continuous knowledge of potential enemies," including all facets of their "political, social, industrial, scientific, and military life" if they were to have advanced "warning of impending danger."[1]

Beginning in 1946, Army Air Forces conducted reconnaissance flights along the borders of the Soviet Union in order to determine the size, composition, and disposition of Soviet forces behind the Iron Curtain.[2] The intelligence collected from these missions was limited, since the aircraft only flew on the periphery of the Soviet Union and its satellite states. Some military leaders at the time recognized that if the United States were to prevent a future surprise attack by the Soviet Union, accurate intelligence was needed before hostilities began. The U.S. leadership determined that acquiring reliable intelligence about the economic and military activities and resources of a potential foreign adversary could only be accomplished through periodic high-altitude overflights in peacetime.[3]

The necessity of peacetime overflights was reinforced after a series of events stunned the United States between 1947 and 1950. A Communist-controlled government assumed power in Poland in 1947. A Communist coup in Prague ended that nation's independence in 1948, and the Soviet Union block-

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
2002		**00-00-2002 to 00-00-2002**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
Space-Based Reconnaissance. From a Strategic Past to a Tactical Future	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Army Space & Missile Defense Command,Army Forces Strategic Command,Redstone Arsenal,AL,35809**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**	**Same as Report (SAR)**	**5**	

While Space-based reconnaissance will always play a critical role in strategic reconnaissance, Space-based tactical reconnaissance is the new challenge.

aded Berlin later the same year. In 1949 the Soviets surprised the United States by detonating their own nuclear device. The United States was further shocked when the Chinese Communists swept to victory in 1949 and the North Koreans launched a surprise attack on South Korea in 1950.

In response to these world events, President Harry S. Truman authorized selected overflights of the Soviet Union in order to determine the status of its air forces. The concern was that the Soviets might launch a surprise aerial attack on the United States with long-range bombers. The new B-47B swept-wing bomber, built by Boeing, was selected to be modified and serve as the first U.S. high-altitude reconnaissance aircraft. The B-47B flew at altitudes of 41,000 feet and was capable of reaching speeds over 500 mph.[4] The first modified B-47B was flown to Fairbanks, Alaska, in preparation for its first overflight of Siberia. Just days before the B-47B was ordered to conduct its first mission, it burned on the ground in a refueling accident.

Two more B-47B bombers were eventually modified, and in 1952 one of these aircraft made the first deep-penetration U.S. overflight of Soviet territory to photograph bombers in Siberia (limited coastal overflights had been conducted by the Air Force and the Navy several months earlier[5]). This mission established the fact that the Soviets were not massing bombers in eastern Siberia. It served to set the important precedent that the President would approve overflights of sovereign nations when the security interests of the United States demanded it.[6]

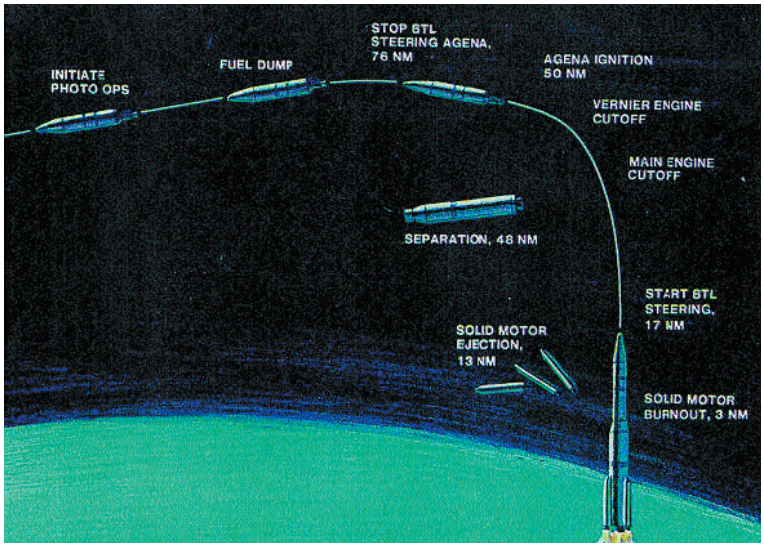
Overflights of the Soviet Union with the newly designated RB-47Es continued through 1954, often at great risk. Many of the flights were conducted in daylight and were routinely intercepted by Soviet MiGs. It became apparent that in order to fly strategic reconnaissance missions safely, a new aircraft was needed that could operate at altitudes well above any Soviet air defenses.

In November 1954, President Dwight D. Eisenhower approved a secret program under the direction of the CIA to build and fly a special-purpose high-altitude reconnaissance aircraft. Named Project AQUATONE, this program designed a fragile but sophisticated jet-powered aircraft that could fly above 70,000 feet and was nearly invisible to radar.[7] Lockheed was chosen to build the reconnaissance plane. In August 1955 the first "U-2" was test-flown in the Nevada desert.[8]

Other strategic reconnaissance missions continued as the U-2 tests were ongoing. In early 1956, Project GENETRIX consisted of high-altitude photoreconnaissance balloons that were intended to collect photographic intelligence as they drifted across the Soviet Union. They were designed to release their gondolas by parachute over the ocean and to be recovered in mid-air by cargo aircraft. In a span of about 4 weeks, 516 of these balloons were released from Turkey and Western Europe. The Soviet air defenses took a heavy toll on the balloons and their payloads, and only 44 gondolas were recovered.[9] Project HOMERUN was conducted between March and May 1956. During that time RB-47E reconnaissance aircraft flew almost daily flights over the North Pole to photograph and gather electronic intelligence over the entire northern section of the Soviet Union.[10]

On July 4th, 1956, the first U-2 flight over the Soviet Union took place. The U-2 did not live up to its expectations as a secret spy plane as the Soviets were able to detect and track the aircraft during the flight.[11] The Soviet leader, Nikita Khrushchev, sharply protested this overflight and feared that "when they understand that we are defenseless against an aerial attack, it will push the Americans to begin the war earlier." This led the Soviet Union to develop new air defense systems and to perfect an intercontinental ballistic missile.[12] President Eisenhower, however, was determined to continue the strategic overflights. Strategic overflight reconnaissance in peacetime became U.S. policy.

President Eisenhower and his advisors continued to develop the means and methods to gather strategic intelligence. Project OXCART advanced aerial overflight reconnaissance with the development of the SR-



CORONA Launch Sequence (Photo courtesy National Reconnaissance Office)

The National Reconnaissance Office has played a crucial role in the development of Space reconnaissance systems that now span nearly the entire electromagnetic spectrum.

71, a supersonic aircraft capable of flying above 80,000 feet.[13] Aerial overflights soon moved out from under the military umbrella, and into the clandestine world of the CIA. Reconnaissance eventually left the atmosphere entirely and moved into Space in the form of satellite reconnaissance.

The CORONA Program

Since the early 1950s, the United States has recognized the potential of strategic reconnaissance to not only warn the nation of an impending surprise attack but also to provide the ability to verify arms-reduction and nuclear test-ban agreements. The idea of Space-based reconnaissance was attractive, because it possessed none of the dangers that aerial overflights did. In July of 1955, President Eisenhower announced plans to launch "small, unmanned, Earth circling satellites as part of the U.S. participation in the International Geophysical Year."[14] Eisenhower's underlying goal, never publicly stated, was to set a precedent by establishing the idea of "freedom of Space." Eisenhower's administration promoted the idea that all nations should have freedom of access to Space and that a nation could not claim a part of Space as an extension of their own airspace. This precedent is still adhered to almost 50 years later.

During the early days of the U-2 flights, the Air Force began studying ways to conduct satellite reconnaissance.[15] American leaders became even more convinced of the need for operational reconnaissance satellites when the Soviet Union successfully launched Sputnik-I on October 4, 1957. Early in 1958, the United States announced an experimental satellite program named Discoverer, which would orbit a series of benign scientific payloads. The entire Discoverer program, however, was an elaborate cover story for Project CORONA, the first U.S. photoreconnaissance satellite program.

The CORONA satellites were designed to be one-time use photography satellites, launched on a Thor intermediate-range ballistic missile with an Agena upper stage. The satellite consisted of a pod that mounted the camera and a recovery capsule into which the exposed film was fed. Lockheed was selected to have system engineering and technical direction responsibilities for the project. General Electric had the responsibility of developing the recovery capsule; Itek eventually won the contract to develop the sophisticated camera that would do the actual intelligence gathering. Itek promised to be able to resolve objects with dimensions of no more than 20 feet, stated as a ground resolution of 20 feet. Initially, 10 CORONA satellites and launch boosters were funded.[16]

Vandenberg Air Force Base was selected as the CORONA launch site. This was one of the few viable launch sites available for the program, since the photoreconnaissance mission required a near-polar orbit. Once the mission was over, the film canister in the recovery vehicle would be jettisoned back to Earth to be recovered over the ocean in mid-air by a C-119 aircraft. The capsule was also designed for a water recovery in the event that the mid-air capture failed. These air recovery techniques had been pioneered during the balloon reconnaissance days of Project GENETRIX. The recovery operation was too large to remain covert, so it was done openly with the explanation that capsule recovery was the only way to ensure the recovery of Discoverer data.

The CIA and the Air Force, who were jointly overseeing the CORONA Program, successfully argued to increase the number of launches to 12. They assumed that only one-third of the launches would be successful and at least four successful flights were required to provide coverage of the Soviet Union.[17] The early estimates turned out to be overly optimistic; CORONA's early days were not auspicious ones.

The first attempt to launch a CORONA satellite failed when some of the upper stage orientation rockets fired on the launch pad. This damaged the upper stage to such an extent that the rocket had to be removed and overhauled.[18] The second attempt, called Discoverer I and launched on February 28, 1959, successfully put a satellite into orbit. No recovery capsule was carried on this mission. The third attempt, Discoverer II, reached orbit, but the capsule was inadvertently released over Norway and never recovered. The next two launches failed to reach orbit. Discoverers V and VI reached orbit, but the cameras on both missions failed on-orbit. The next

CORONA image of the Pentagon taken on Sept. 25, 1967. (Photo courtesy National Reconnaissance Office)

two launches, Discoverers VII and VIII, were failures as well when the cameras malfunctioned again.[19]

The total number of authorized CORONA flights was now up to 20 in the optimistic hope that the system would eventually work as advertised.

Despite Lockheed, the Air Force, and the CIA scrutinizing the program after each failure, the failures continued. Discoverers IX and X never reached orbit (Discoverer X had to be destroyed over Vandenberg during launch). Discoverer XI experienced a recovery system malfunction, and Discoverer XII failed to achieve orbit.[20] Of the original twelve CORONA payloads that had been authorized, under the assumption that one-third of them would be successes, not one capsule had been recovered. The situation became grave for the United States on May 1, 1960, when Francis Gary Powers was shot down in his U-2 aircraft over the Soviet Union. President Eisenhower quickly ordered a stop to all strategic overflights.

Discoverer XIII, launched on August 10, 1960, as a diagnostic flight with no camera on board, successfully jettisoned its recovery capsule over the Pacific Ocean. Although the attempted aerial recovery failed, the capsule was safely recovered from the sea. After two years, there was hope that the CORONA Program might bear fruit. On August 18, 1960, Discoverer XIV was launched with a CORONA camera on board. The launch vehicle, satellite, and camera all performed flawlessly, and all 20 pounds of exposed film were successfully recovered in mid-air. After development, the 3,000 feet of film revealed 1,650,000 square miles of the Soviet Union that had been photographed at a ground resolution of about 35 feet. The Discoverer XIV mission alone produced more coverage of the Soviet Union than all U-2 missions combined.[21]

Improvements in the satellite and camera systems were made throughout the CORONA Program. Camera shutter speeds were improved and sharpened the images, while the ground resolution continued to improve until objects measuring less than five feet across could be resolved. Stereo cameras were used in most of the later CORONA missions to allow accurate mapping of the interior of the Soviet Union. Satellite vehicles evolved to the point where two film recovery systems were orbited on a single vehicle. This allowed the satellite to collect and return a series of pictures, and then lie dormant until another set of pictures was required.

The CORONA Program, although firmly established by 1963, still suffered occasional setbacks. A CORONA mission in March of 1964 failed when the film in the camera snapped. With the eventual failure of the power supply, the orbit decayed until the capsule reentered the atmosphere. Calculations of the impact point predicted that the capsule would splash into the ocean off the coast of South America. Several bright objects were seen in the sky over Venezuela on May 26, 1964, as the CORONA capsule returned to Earth. Two months later, the Air Force was shocked to learn that a Venezuelan farmer found the battered capsule in a remote rural area near the Colombian border. The capsule was clearly marked "United States." The CIA moved quickly to recover the capsule, but not before local farmers dismantled part of it for souvenirs.[22]

The CORONA Program continued until 1972 and became, despite its initial setbacks, one of the great early achievements of U.S. strategic reconnaissance. CORONA eventually involved 145 launches and covered a total of 750 million square nautical miles.[23] Using the CORONA intelligence, the United States had an unobstructed view behind the Iron Curtain.

National Reconnaissance Office

In 1961, President John F. Kennedy established the National Reconnaissance Program, which would consist of "all satellite and overflight reconnaissance projects whether overt or covert."[24] He also established the National Reconnaissance Office to oversee the program. The CORONA Program was transferred to its control along with the Navy's Gallactic Radiation and Background (GRAB) Satellite Program (GRAB was actually the first successful U.S. reconnaissance satellite, designed to collect signals intelligence of Soviet air-defense systems).

(See Reconnaissance page 36)

RECONNAISSANCE ... from Page 31

For 40 years, the National Reconnaissance Office has revolutionized strategic reconnaissance. Film capsule recovery satellites have been replaced with near-real-time electro-optical imagers, and signals intelligence gatherers continue to push the limits of technology. The Office has played a crucial role in the development of Space reconnaissance systems that now span nearly the entire electromagnetic spectrum. Intelligence gathering is no longer limited to nuclear disarmament issues and the prevention of surprise attacks, but includes such efforts as monitoring international terrorists and drug cartels, monitoring the proliferation of weapons of mass destruction, and aiding in natural disaster relief.

Until the World War II era, tactical reconnaissance was all that was possible. As technology has evolved, so has our ability to conduct strategic reconnaissance. This evolution of reconnaissance is entering a new phase, in which the goal is to apply our formidable strategic capabilities to our tactical efforts. This will require the same focused effort, ingenuity, and perseverance that made our strategic program a success. While Space-based reconnaissance will always play a critical role in strategic reconnaissance, Space-based tactical reconnaissance is the new challenge.

Maj. Robert Guerriero graduated from the United States Military Academy in 1990 and was commissioned as an Armor officer. He is now a Space Operations Officer assigned to the National Reconnaissance Office's Advanced Systems and Technology Directorate.

End Notes

1 Gen H. H. Arnold, Third Report of the Commanding General of the Army Air Forces to the Secretary of War, USAAF, Nov. 12, 1945, pp. 65 and 67.
2 R. Cargill Hall, The Truth about Overflights, The Quarterly Journal of Military History, 1997, Vol. 9, No. 3, p. 26.
3 R. Cargill Hall, Strategic Reconnaissance in the Cold War, Prologue, 1996, Vol. 28, No. 2, p. 107.
4 Hall, 1997, p.28.
5 Hall, 1997, p.31.
6 Hall, 1996, p.114.
7 Hall, 1997, p.36.
8 Hall, 1996, p.119.
9 Hall, 1997, p.36.
10 Hall, 1997, p.36.
11 Hall, 1996, p.119.
12 Hall, 1996, p.120.
13 Hall, 1997, p.39.
14 Hall, 1996, p.119.
15 Frederic C.E. Oder, James C. Fitzpatrick, and Paul E. Worthman, The Corona Story, 1987, p.3.
16 Oder, Fitzpatrick, and Worthman, 1987, p.28.
17 Oder, Fitzpatrick, and Worthman, 1987, p.40.
18 Oder, Fitzpatrick, and Worthman, 1987, p.47.
19 Oder, Fitzpatrick, and Worthman, 1987, pp.47-49.
20 Oder, Fitzpatrick, and Worthman, 1987, pp. 50-51.
21 Oder, Fitzpatrick, and Worthman, 1987, pp. 52-61.
Space-Based Reconnaissance, Guerriero, 8
22 Oder, Fitzpatrick, and Worthman, 1987, p.96.
23 Oder, Fitzpatrick, and Worthman, 1987, p.121.
24 R. Cargill Hall, The NRO at Forty: Ensuring Global Information Supremacy, 2001.